. seasons was 195 and 233 mm respectively, with ,infall was 2570 mm.

, and blood samples collection: The forage evaluated ,isted 13 species of grass (*Axonopus compressus, ,nnisetum purpuphoides, Pennisetum purpureum, Setaria sphacelata, Cynodon plectotachyus, Panicum maximum, Paspalum notatum, Paspalum dilatatum, Brachiaria decumbens, Euchlaena mexicana, Andropogon gayanus, Havea hexandra* and *Cynodon dactylon*) and 7 species of legumes (*Leucaena leucocephala, Gliricidia maculata, Calopogonium mucunoides, Centrosema pubescens* and *Mimosa pudica*). Immediately after harvesting, representative samples were dried at 60°C for 24 hours, ground in a Wiley mill through 1–mm screen and kept for further analyses. At the same time, blood samples were collected by jugular puncture from about 30 goats at each season and region. Mineral concentration in forages and blood plasma were analyzed by Inductively Coupled Plasma Emission Spectrometer (ICPS-2000, Shimadzu, Japan). The difference of the average mineral concentration between dry and rainy season was determined using Student's t-test [5].

Results and Discussion

As shown in Table 1, the mineral concentration of grass significantly was affected ($p<0.05$) by species and season. Between forages evaluated, *P. maximum* contained highest Ca concentration (avg. 9.6 g/kg) while the lowest concentration was found in *P. purpuphoides* (avg. 5.9 g/kg). The mean concentration of P varied from 2.1 (*E.mexicana*) to 4.7 g/kg (*S. sphacelata*), Mg from 2.3 (*C. dactylon*) to 4.2 g/kg (*A. compressus*) and S ranged from 1.7 (*P. purpuphoides, E. mexicana*) to 6.9 g/kg (*A. compressus*). The difference of mineral contents between species could be caused by genetic factors, botanical composition and characteristics of growth as suggested by Underwood and Suttle[3] and Jumba *et al.*[6]

Table 1. Concentration of Ca, P, Mg and S of grass harvested at dry and rainy seasons (g/kg DM).

Species	Season	Ca	P	Mg	S
Critical level*	---	3.0	2.5	2.0	2.6
A. compressus	Rainy	7.4	3.6	4.4	7.5
	Dry	7.1	2.6	4.0	6.3
P. purpuphoides	Rainy	5.3	3.8	2.2	1.6
	Dry	6.5	4.6	2.8	1.8
S. sphacelata	Rainy	7.0	6.2	3.5	4.7
	Dry	6.6	3.3	2.1	2.1
C. plectostachyus	Rainy	7.7	4.7	2.0	5.0
	Dry	9.0	4.4	3.5	2.5
P. purpureum	Rainy	6.0	5.9	3.2	3.6
	Dry	6.1	2.8	2.3	1.9
P. notatum	Rainy	5.9	2.0	2.2	4.1
	Dry	8.5	2.5	3.3	2.9
P. maximum	Rainy	10.7	4.3	3.5	2.6
	Dry	8.5	2.5	3.3	2.9
B. decumbens	Rainy	7.4	2.0	3.8	1.7
	Dry	6.8	2.3	3.2	1.9
E. mexicana	Rainy	3.9	1.7	1.7	1.7
	Dry	10.1	2.5	4.0	1.7
A.gayanus	Rainy	8.9	2.4	3.3	1.4
	Dry	6.6	4.1	2.8	3.6
H. hexandra	Rainy	6.1	3.8	2.2	3.2
	Dry	5.7	4.5	2.7	4.2
P. dilatatum	Rainy	8.8	3.5	3.2	4.0
	Dry	6.4	4.3	2.1	3.2
C. dactylon	Rainy	5.9	2.2	1.4	4.0
	Dry	6.9	2.7	3.2	5.6
Mean	Rainy	7.2	3.5	2.9	3.3
	Dry	7.0	3.6	2.8	3.4
	Overall	7.3	3.3	3.0	3.1
Deficiency (%)	Rainy	0	30.8	23.1[a]	30.8[b]
	Dry	0	30.8	0.0[b]	46.2[a]
	Overall	0	30.8	11.6	38.5

*Concentration below the critical level is deficient
a, b : significantly different ($p < 0.05$).

Percentage deficiency of P, Mg and S was significantly affected by season ($p<0.05$). Deficiency of P, Mg and S in rainy season was 30.8, 23.1 and 30.8%, while deficiency of P and S in dry season was 30.8 and 46.2%, respectively. Deficiency of Mg in the present study was slightly higher compared to the results of Minson [7] who obtained less than 14% of tropical forages deficient in Mg and thus suggested that Mg was not limiting element in tropical forages, the mean Mg concentration being 3.6 g/kg. Among the minerals evaluated, the highest availability was observed for Ca in almost all grasses observed, concentration being above the critical level, 3.0 g/kg [1]. On the other hand Prabowo *et al.* [4] reported that Ca and P were deficient in most forages grown in South Sulawesi, Indonesia. In comparison with our study, lower nutrient levels in their study might be caused by dissimilarities in forage species evaluated, climate and soil type and fertility.

Table 2 shows macro mineral concentrations of legume forages. The concentration of Ca in all species of legumes was higher than that of critical level [1] with the average value ranging from 13.0 g/kg in *M. pudica* to 16.4 g/kg in *G. maculata*. The mean concentration of Ca in legumes was higher compared with Ca concentration in grass (13.8 vs 7.3 g/kg), while concentration of P in legumes was lower compared with that of grass (2.4 g/kg vs 3.5 g/kg). These findings are in agreement with the results obtained by Minson [7] and Serra *et al.* [8]. As shown in Table 2, effect of season was significant on concentration of P, Mg and S

Table 2. Concentration of Ca, P, Mg and S of legumes harvested at dry and rainy seasons (g/kg DM).

Species	Season	Ca	P	Mg	S
Critical level*	----	3.0	2.5	2.0	2.6
L. leucocephala	Rainy	15.5	2.7	2.7	4.4
	Dry	15.0	2.4	3.7	3.3
G. maculata	Rainy	16.9	2.4	2.5	3.4
	Dry	15.9	1.8	3.6	2.6
C. mucunoides	Rainy	16.1	2.4	3.5	3.0
	Dry	14.7	1.8	5.2	2.4
M. pudica	Rainy	13.9	2.0	1.6	3.0
	Dry	12.1	2.4	2.7	2.8
C. pubescens	Rainy	14.8	2.5	1.8	3.0
	Dry	12.0	2.4	2.6	2.3
M. Invisa	Rainy	16.7	2.1	2.2	2.0
	Dry	15.1	2.1	3.6	2.2
S. glandiflora	Rainy	15.8	4.5	3.9	3.8
	Dry	11.9	3.8	2.6	3.7
Mean	Rainy	14.7	2.4	3.0	3.0
	Dry	15.7	2.7	2.6	3.2
	Overall	13.8	2.1	3.4	2.8
Deficiency (%)	Rainy	0.0	71.4[a]	28.6[b]	14.3[a]
	Dry	0.0	85.7[b]	0.0[a]	42.9[b]
	Overall	0.0	78.6	14.3	28.6

*Concentration below the critical level is deficient
a, b : significantly different ($p < 0.05$).